

THAT WHICH IS CLAIMED:

1. A composite-metallic hybrid fastener for installation in an aperture through structural members for fastening the structural members, the fastener comprising:

5 a metallic stem defining a shank extending between first and second ends, the stem defining a deformable first head at the first end of the shank; and

a composite sleeve defining first and second sides, a second head at the second side, and an aperture extending between the first and second sides, the second head having a cross-sectional dimension greater than a cross-sectional dimension of the aperture through the structural members,

10 wherein the shank is configured to be disposed through the apertures of the structural members and the sleeve, and the first head is adapted to be urged toward the sleeve and thereby deformed to a cross-sectional dimension greater than the cross-sectional dimension of the aperture through the structural members such that the structural members are fastened between the first and second heads of the stem and the sleeve.

2. A fastener according to Claim 1 wherein the aperture through the sleeve is threaded and the shank of the stem defines corresponding threads such that the shank is configured to be screwed into the sleeve and the first head is configured to be urged toward the sleeve and deformed against the sleeve by rotating the stem relative to the sleeve.

25 3. A fastener according to Claim 1 wherein at least one of the stem and the sleeve are pre-coated with a curable organic coating.

4. A fastener according to Claim 1 wherein the first head defines an annular portion extending around the shank, the annular portion being adapted to deform to a cross-sectional dimensional size at least as great as the cross-sectional dimensional size of the aperture.

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5. A fastener according to Claim 1 wherein the stem defines a breakneck feature such that the stem is configured to fail at the breakneck feature after the first head has been fully deformed.
- 5 6. A fastener according to Claim 1 wherein the metallic stem is formed of at least one of the group consisting of titanium and titanium-alloy materials.
7. A fastener according to Claim 1 wherein the composite sleeve comprises fibers disposed in a polymeric resin matrix, the fibers being formed of  
10 at least one of the group consisting of carbon and fiberglass.
8. A fastener according to Claim 1 wherein the composite sleeve comprises fibers disposed in a polyetheretherketone matrix, the fibers being formed of at least one of the group consisting of carbon and fiberglass.  
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9. A fastener according to Claim 1 further comprising a plastic insert disposed between the stem and the sleeve and configured to form a seal therebetween when the first head is deformed.
- 20 10. A fastener according to Claim 1 further comprising an annular metallic locking ring disposed between the stem and the sleeve and configured to be engaged therebetween.
11. A blind composite-metal hybrid fastener for fastening structural  
25 members defining an aperture extending between first and second sides of the structural members, the fastener comprising:
- a shank extending between first and second ends;
  - a deformable first head connected to the first end of the shank; and
  - a second head connected to the second end of the shank, the second  
30 head having a cross-sectional dimension greater than a cross-sectional dimension of the aperture,
- wherein the first head defines a cross-sectional dimension less than the cross-sectional dimension of the aperture such that the first head is configured to be inserted through the aperture of the structural members from the first side to the

second side of the structural members and thereafter deformed to a cross-sectional dimension greater than the cross-sectional dimension of the aperture by a blind adjustment of the second head and the shank at the first side of the structural members, thereby fastening the structural members between the first and second heads, and wherein at least a portion of the fastener is formed of a composite material including a reinforcement material disposed in a polymeric resin matrix material and at least a portion of the fastener is formed of a metallic material.

12. A blind composite-metal hybrid fastener according to Claim 11 wherein the second head is formed of the composite material.

13. A blind composite-metal hybrid fastener according to Claim 12 wherein the composite material comprises fibers disposed in a polymeric resin matrix, the fibers being formed of at least one of the group consisting of carbon and fiberglass.

14. A blind composite-metal hybrid fastener according to Claim 12 wherein the composite material comprises fibers disposed in a polyetheretherketone matrix, the fibers being formed of at least one of the group consisting of carbon and fiberglass.

15. A blind composite-metal hybrid fastener according to Claim 11 further comprising a sleeve extending from the second head, the sleeve defining a cross-sectional dimension smaller than the cross-sectional dimension of the aperture such that the sleeve is configured to be disposed through the aperture with the shank extending through the sleeve.

16. A blind composite-metal hybrid fastener according to Claim 15 wherein the sleeve defines an aperture that is at least partially threaded and the shank defines threads corresponding to the threaded aperture of the sleeve such that the shank is configured to be screwed into the sleeve and compressed toward the sleeve by rotation of the shank relative to the sleeve.

17. A blind composite-metal hybrid fastener according to Claim 11 wherein at least a portion of the fastener is pre-coated with a curable organic coating.

5 18. A blind composite-metal hybrid fastener according to Claim 11 wherein the shank defines a breakneck feature such that the shank is configured to fail at the breakneck feature after the first head has been fully deformed.

10 19. A blind composite-metal hybrid fastener according to Claim 11 wherein the shank is formed of a metallic material.

20. A blind composite-metal hybrid fastener according to Claim 19 wherein the shank is formed of at least one of the group consisting of titanium and titanium-alloy materials.

15 21. A blind composite-metal hybrid fastener according to Claim 11 wherein the first head defines an annular portion extending around the shank, the annular portion being adapted to deform to a cross-sectional dimensional size at least as great as the cross-sectional dimensional size of the aperture.

20 22. A blind composite-metal hybrid fastener according to Claim 11 wherein the shank and the first head are integral members.

25 23. A blind composite-metal hybrid fastener according to Claim 11 further comprising a plastic insert disposed between the stem and the sleeve and configured to form a seal therebetween when the first head is deformed.

30 24. A blind composite-metal hybrid fastener according to Claim 11 further comprising an annular metallic locking ring disposed between the stem and the sleeve and configured to be engaged therebetween.

25. A blind composite-metal hybrid fastener according to Claim 11 wherein at least a portion of the fastener is formed of at least one of the group consisting of titanium and titanium-alloy materials.

26. A method of fastening structural members with a fastener formed at least partially of a composite material, the method comprising:

providing a fastener having a deformable first head, a second head, and a shank extending therebetween, at least a portion of the fastener being formed of a composite material and at least a portion of the fastener being formed of a metallic material;

disposing the shank of the fastener in an aperture defined by the structural members such that the second head is disposed at a first side of the structural members and the deformable first head defining a cross-sectional dimension at least as great as a cross-sectional dimension of the aperture is disposed at a second side of the structural members opposite the first side; and

deforming the first head to a cross-sectional dimension at least as great as the cross-sectional dimension of the aperture and thereby fastening the structural members between the heads of the fastener.

27. A method according to Claim 26 wherein said providing step comprises providing the second head formed of the composite material.

28. A method according to Claim 26 wherein said providing step comprises providing a sleeve extending from the second head, the sleeve defining a cross-sectional dimension smaller than the cross-sectional dimension of the aperture, and said disposing step comprises disposing the sleeve through the aperture with the shank extending through the sleeve.

29. A method according to Claim 26 further comprising pre-coating at least a portion of the fastener with a curable organic coating.

30. A method according to Claim 26 further comprising failing the shank after said deforming step and removing a portion of the shank from the fastener.

31. A method according to Claim 26 wherein said providing step comprises providing the shank formed of a metallic material.

32. A method according to Claim 26 wherein said disposing and deforming steps comprise blindly disposing the fastener from the first side of the structural members and deforming the first head from the first side of the structural members.

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33. A method according to Claim 26 wherein said deforming step comprises deforming a plastic insert with the first head such that the plastic insert forms a seal between the first and second heads.

10 34. A method according to Claim 26 further comprising disposing an annular metallic locking ring between the stem and the sleeve and thereby engaging the stem and the sleeve with the locking ring therebetween.

15 35. A method according to Claim 26 further comprising providing the structural members, at least one of the structural members being formed of a composite material.

20 36. A method according to Claim 26 further comprising providing the structural members, at least one of the structural members being formed of a composite material and at least one of the structural members being formed of a metallic material.

25 37. A method according to Claim 36 wherein said providing step comprises providing at least one of the structural members being formed of at least one of the group consisting of titanium and titanium-alloy materials.